

4/PHY-250 Syllabus-2023

2026

(May-June)

FYUP : 4th Semester Examination

PHYSICS

(Optics II and Acoustics)

(PHY-250)

Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions.

Answer *any ten* questions.

1. (a) Show that $t = \frac{f_1 + f_2}{2}$ for minimum chromatic aberration for two lenses of focal lengths f_1 and f_2 when they are separated by a distance t and they are of the same material. 5½
- (b) Name any four common defects in the images produced by a single lens. 2
2. (a) Explain spherical aberration in a convex lens with a neat diagram. 4½

(2)

- (b) Briefly describe any two methods to minimize spherical aberration (avoid mathematical derivations). 3
3. (a) Describe the construction of Ramsden eyepiece. Show that the equivalent focal length of the eyepiece is $\frac{3}{4}f$, where f is the focal length of the eye lens. $3+2\frac{1}{2}=5\frac{1}{2}$
- (b) State any two points of differences between the Huygens eyepiece and Ramsden eyepiece. 2
4. (a) Determine the wavelength of sodium light by using Newton's rings. 5
- (b) In the above experiment, the diameter of the 15th ring is 0.590 cm and that of the 5th ring is 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light used. $2\frac{1}{2}$
5. (a) Describe the construction and working of a Fabry-Perot interferometer with a neat diagram. $3+2\frac{1}{2}+1=6\frac{1}{2}$
- (b) What are Haidinger fringes? 1
6. (a) Show that the focal length of a Zone plate is $f_n = r_n^2 / n\lambda$, where the symbols have their usual significances. 5

(3)

- (b) Find the radius of the first zone in a zone plate of focal length 20 cm for light of wavelength 5000 Å. $2\frac{1}{2}$
7. Explain the construction and the mode of action of a diffraction grating. Derive an expression for its resolving power. $2\frac{1}{2}+2+3=7\frac{1}{2}$
8. Describe and explain Fraunhofer diffraction pattern obtained with a narrow slit illuminated by a parallel beam of monochromatic light. $7\frac{1}{2}$
9. (a) What is a quarter-wave plate? Show that
- $$t = \frac{\lambda}{4(\mu_e - \mu_o)}$$
- where the symbols have their usual significances. $1+2\frac{1}{2}=3\frac{1}{2}$
- (b) What is a half-wave plate? Calculate the thickness of a half-wave plate given that $\mu_e = 1.553$, $\mu_o = 1.544$ and the wavelength of light used is 5000 Å. $1+3=4$
10. (a) What are ultrasonic waves? Describe one method used to detect them. Mention any two of its uses. $1+2+2=5$
- (b) If the amplitude of a sound wave is doubled, find the increase in the loudness. $2\frac{1}{2}$

(4)

11. (a) What are the requirements of a good auditorium? 4
(b) What is reverberation time? 1½
(c) Explain decibel in sound intensity. 2
12. (a) A periodic function is given by
$$f(t) = 0 \text{ for } 0 < t \leq \frac{T}{2}$$
$$= 1 \text{ for } \frac{T}{2} < t \leq T$$
Expand $f(t)$ in a Fourier series. 4½
(b) What is noise? Give a brief qualitative description of how noise can be reduced. 1+2=3
13. (a) Explain double refraction through uniaxial crystal. Discuss the electromagnetic theory of double refraction. 2+3=5
(b) Give the theoretical explanation of dispersion of light. 2½
14. (a) What is polarization of light? Explain how polarized light is produced by reflection. 1½+2=3½
(b) Explain briefly one method each for the detection of plane polarized light and circularly polarized light. 1½+2½=4

(5)

15. (a) State and explain Brewster's law. Using this law, show that when light is incident on a transparent medium at a polarising angle, the reflected and refracted rays are at right angle. 2+3½=5½
(b) Calculate the polarizing angle for a glass medium whose refractive index is 1.52. 2
16. (a) Deduce Sabine formula for the reverberation time of a live room. 5
(b) A room has a volume of 800 m³ and a total surface area of 500 cm² with an average absorption coefficient of 0.2. Find the reverberation time. 2½
